omy. We only wish the publisher had done as well as the authors. The illustrations are numerous, and probably sufficient to fulfil the end of helping the student in his work; but, from an artistic point of view, they are, with rare exceptions, simply atrocious.

MINOR BOOK NOTICES.

Guesses at purpose in nature, with especial reference to plants. By W. POWELL JAMES, M.A. London, 1883. 192 p. 12°.

THIS is a little book of ten chapters, which has just reached us, and which we would notice with a word or two in addition to an announcement of its title. The author, we fancy, is a clergyman and merely an amateur naturalist. However that may be, his *guesses* are shrewd, and the way of putting them is taking. Considering the great number and variety of the facts he has collected,—the greater part from books,—he has fallen into few mistakes; so that the volume has more scientific value than is usual in such treatises.

An outline of qualitative analysis for beginners. By JOHN T. STODDARD, PH.D, professor of chemistry in Smith college. Northampton, *Gazette printing company*, 1883. 4+54 p. 16°.

The general plan of this work will doubtless be recognized as one which gives the best results in teaching qualitative analysis. To a certain extent it is faulty in detail, both as regards convenience of arrangement and the selection of methods. Although this criticism applies more especially to the course of basic analysis, if advantage were taken of differences in solubility of certain barium, calcium, and silver salts of the acids, it would save the student much time and labor in general analysis. An appended list of the names and symbols of the more common reagents will be found useful.

A short course on quantitative analysis. By JOHN HOWARD APPLETON, A.M., Brown university. Philadelphia, *Cowperthwait & Co.*, 1881. 183 p., cuts. 12°.

The course of analysis presented in this work consists, with few exceptions, of a judicious selection of methods and determinations. The descriptions of processes and apparatus will undoubtedly be of much service in the laboratory, although considerable descriptive chemistry is introduced with which the student is supposed to be familiar before undertaking quantitative analysis. An exception will probably be taken to the completeness of the notes and explanations, which leave little opportunity for thought or study on the part of the student.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

Alignment curves on the ellipsoid.—Mr. C. H. Kummell describes several curves that represent the straight line, all of which, on the sphere, reduce to the great circle. The *vertical section* is traced by the surveyor at one end, who fixes points in range with the other end. The *proörthode* (πρό, ὀρθός, ὁδός) results, if the alignment at each point is determined at a point previously fixed, the distance between the two being infinitesimal. It is followed in chaining, or more roughly by the pedestrian in moving toward an object. In these two curves no back-sight is taken: they are differently related to the two ends, and do not return upon themselves. The *diorthode* (διά) is the locus of all points at which the vertical plane through one terminal point also includes the other. It is used in laying out primary base-lines, the points of which are determined by making fore-sights and back-sights differ always by 180°. This curve has been confounded with the preceding by Dr. Bremiker (*Studien über höhere geodäsie*, 1869) and others; but the proörthode is everywhere tangent to the vertical plane passing through one terminal point, while the diorthode, except at the ends, is not. The curve of shortest distance between two points, often called the 'geodetic line,' would more properly be called the *brachisthode* (βράχιστος). These names were suggested by Mr. W. R. Galt of Norfolk, Va.

Mr. Kummell shows the diorthode to be the intersection of the ellipsoid with a hyperboloid of one sheet. In the case of an ellipsoid of revolution, this is the parabolic hyperboloid. Taking the three principal axes, a, b, c, as axes of x, y, and z, he represents the points where the chord connecting the two termini of the proposed alignment pierces the planes xy, xz, yz, by $(x_z, y_z, 0)$, $(x_y, 0, z_y)$, and $(0, y_x, z_x)$, respectively, and introduces quantities,—

$$a_b{}^2 = 1 - \frac{a^2}{b^2}, \quad a_c{}^2 = 1 - \frac{a^2}{c^2},$$

and so, by cyclic permutation of letters, $\beta_c{}^2$ and $\beta_a{}^2$, $\gamma_a{}^2$ and $\gamma_b{}^2$; where the ratio of each of his first set of auxiliary quantities to one of his last gives one of the co-ordinates of position of those generatrices of the hyperboloid which are perpendicular to the co-ordinate planes. The equation of the hyperboloid is,—

$$\left(x - \frac{x_y}{\beta_a{}^2}\right)\left(y - \frac{y_z}{\gamma_b{}^2}\right)\left(z - \frac{z_x}{a_c{}^2}\right) = \left(x - \frac{x_z}{\gamma_a{}^2}\right)\left(y - \frac{y_x}{a_b{}^2}\right)\left(z - \frac{z_y}{\beta_c{}^2}\right),$$

and it passes though the centre of the ellipsoid.

The diorthode cannot be traced practically, because of the curvature of the earth. Mr. Kummell has investigated the locus of all points through which one tangent line meets the normals drawn at the two extremities, and finds its intersecting surface to be of